aligning the two substrates and firing. The filler material volatilizes during firing, forming an air gap around the metal which reduces the effective dielectric constant of the insulator.

This method does not disclose embossing, forming transmission lines or openings for buried passive components, and no filling of the openings at all, as required by the present claims.

Alternatively it is suggested to cut or stamp openings in green tape and fill them with a metal paste. Other openings are filled with filler paste, which, after firing, volatilize to make openings in the fired green tape.

claims channel or opening

The purpose of IBM is not to form transmission lines and openings for buried passive components at all. The openings as described in IBM are not large openings suitable for receiving passive components, such as capacitors and resistors, but to surround patterned metal conductors, e.g., dots or contacts, to reduce the effective dielectric constant of insulators between the conductors.

In the patterns required by applicants, openings are made by embossing openings of a predetermined shape and size directly onto the green tape, and filling with component material in the

form of a suitable ink. This ink is not meant to be volatilized to form a hole, but to form a component. No unfilled openings are to be formed, or are formed, in applicants' method.

The method of IBM cannot form exact fired patterns because their openings are formed during firing, and thus these openings are not filled prior to firing either. Further, due to non-uniformities of shrinkage of green tape insulator material during firing, they cannot obtain an exact replica of a pattern such as can be obtained by embossing, filling and then firing, in that sequence. The method of applicants results in improved RF loss characteristics, improved tolerances of buried passive components, and improved definition of lines.

Since the IBM reference cannot obtain the results of applicants process, the Examiner has combined IBM with Amendola et al. This reference teaches that green sheets shrink non-uniformly during sintering, so that filled via holes that are fired do not have the exact pattern of the unfired material, and do not match an unfired patterned top layer.

Amendola et al's response to this is to fire the green sheet stack, then metallize the green sheet top layer pattern and fire it the same way, so that alignment can be obtained. However, this

method requires plural patterning and plural firing steps.

Alternatively, a colored material is wiped into grooves in a fired stack, a photo is taken of the fired pattern and used to make a photomask of the actual fired pattern. Metal is deposited into the grooves made from this photomask.

This is also a multi-step process.

The present method first embosses the desired pattern into a green tape, then fills the pattern prior to firing; adding a separate top layer is not required. The present embossed and filled green tapes are part of a metal supported system that prevents x and y shrinkage of green tape stacks. Thus the multi-step method of Amendola et al is not necessary. Applicants can emboss and fill grooves prior to firing because x and y shrinkage does not occur during the firing step.

The Examiner states that a silver ink having a viscosity of about 30 poise would be obvious; however, standard silver-based conductor inks have a viscosity nearer to 45 poise; thus the present low viscosity inks include more silver, which improves their conductivity.

Thus applicants submit that even when Amendola et al is combined with the primary reference, the present method is not

suggested. Applicants do not fire between the embossing and filling steps.

Claims 4-7 have been rejected over IBM and Amendola et al further in view of Vitriol et al. These claims are directed to filling openings made in the green tape with resistor or capacitor inks.

The inadequacies of the IBM and Amendola et al references have been explained above.

Vitriol et al disclose screening openings into green tapes and filling the openings with materials to make resistors, capacitors, inductors and the like by screen printing. There is no mention of embossing the lines and patterns to be filled. Thus this reference, even when combined with the prior discussed references, does not meet the requirements of the present claims either.

Claims 9 and 11, directed to a method of making buried passive components comprising embossing a desired opening under heat and pressure so as to transfer a pattern from an embossing tool to a green tape, filling the opening with an ink of a component material, burying the green tape in a green tape stack, aligning and laminating the stack onto a metal support board

having a low melt temperature glass thereon and firing the stack, have been rejected under 35 USC 103(a) over the IBM and Amendola et al references further in view of Prabhu.

The primary references and their inadequacies have been detailed above. Prabhu does disclose the use of a metal support board for a green tape stack and that, when the metal board is adhered to a green tape stack by means of a low melt temperature glass, the green tape x and y shrinkage generally found when firing green tape, is much reduced.

However, the present claims 9 and 11 require first embossing an opening in a green tape directly with a pattern and filling the opening with a component material, burying the green tape in a green tape stack, aligning and laminating the stack onto a metal support board and only then firing the stack. This method is not taught by the references. The advantages of the present method are that the problem of shrinkage is eliminated, directly embossing a pattern into a green tape prior to firing maintains excellent patterning tolerances of the green tape while permitting embossing a variety of predetermined openings and vias, as well as eliminating thickness, width and length variations for tighter tolerances of length and thickness for

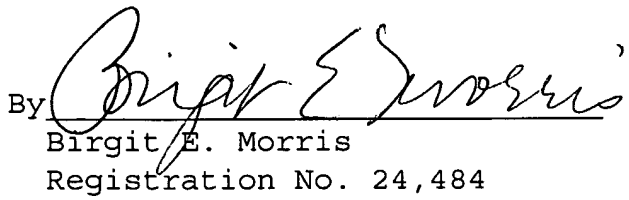
improved performance and reproduceability. Thus the present method is an improvement over the prior art and permits patterns to be made which retain their features in the x and y dimensions through the firing step.

In view of the above discussion, applicants submit the present claims are allowable and should be passed to issue. Accordingly, reconsideration of the present claims is respectfully solicited.

If the Examiner believes a telephone interview would advance the prosecution of this application, he/she is invited to contact the undersigned.

Respectfully submitted,

MICHAEL JAMES LIBERATORE et al

By 
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The undersigned certifies that this correspondence is being deposited as first class mail with the United States Postal Service in an envelope addressed to the Assistant Commissioner for Patents, Washington, DC 20231 on

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